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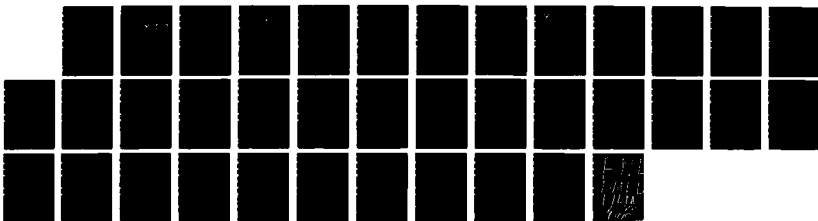
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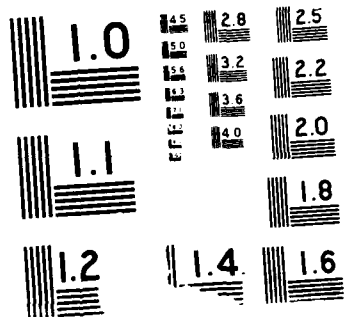
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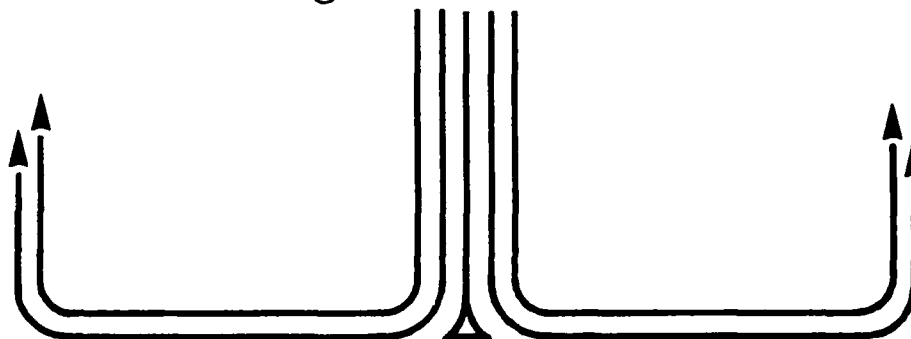
STUDENT REPORT

BOOK ANALYSIS: COMMAND AND
CONTROL OF THEATER FORCES: ADEQUACY

MAJOR JOHN J. WRIGHT

88-2810

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REPORT NUMBER 88-2810

TITLE BOOK ANALYSIS: COMMAND AND CONTROL OF THEATER FORCES: ADEQUACY

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<p>This study analyzes the book, <u>Command and Control of Theater Forces: Adequacy</u>, by John H. Cushman. Cushman's thesis is that our theater command and control systems are seriously deficient, due primarily to a flawed requirements and acquisition process. This study provides a synopsis of Cushman's specific criticisms and analyzes them in terms of other sources and recent developments. The study concludes Cushman's book raises some valid points, though recent developments such as JCS reform are potential solutions. ↗</p>			
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PREFACE

This study will examine the book, Command and Control of Theater Forces: Adequacy, by John H. Cushman. In the book, Cushman raises serious criticisms of the state of our theater command and control systems and the acquisition process that provides them. A knowledge of these issues and the environment of theater command and control is important for today's military officer.

The author would like to acknowledge the assistance of Major Don Ottinger, Air Command and Staff College faculty advisor, for his technical and editorial guidance.



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EXECUTIVE SUMMARY

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"insights into tomorrow"

REPORT NUMBER 88-2810

AUTHOR(S) MAJOR JOHN J. WRIGHT, USAF

TITLE BOOK ANALYSIS--COMMAND AND CONTROL OF THEATER FORCES:
ADEQUACY

I. Purpose: To analyze the major conclusions of the author, John H. Cushman, Lt Gen, USA (Ret), on the poor performance of our acquisition process for theater command and control systems.

II. Data: Cushman argues that, due to certain technical/conceptual and bureaucratic/institutional reasons, our system for acquiring systems for command and control of theater forces is seriously inadequate. His causes of poor performance can be summarized into five problems. One, we don't understand the holistic and complex, living nature of theater command and control systems. Two, we don't use an evolutionary acquisition approach incorporating available commercial equipment. Three, we don't have an architectural framework that facilitates interoperability. Four, we don't give the user, either directly or through the Joint Chiefs of Staff (JCS), sufficient influence in the acquisition process. Five, we don't realistically evaluate, either in development or in operation, our theater command and control systems.

CONTINUED

Continuing interoperability problems are indicative of both our lack of understanding of the full nature of command and control systems as well as our lack of an architectural framework. Evolutionary approaches have resulted in improved acquisition performance but there are implementation obstacles. Among these are competing in the requirements and budget process, test and evaluation, developing maintenance capability, and contracting issues. Keys to solving these problems are overcoming resistance to the required changes in acquisition procedures and blending the roles of the user and development organizations. A number of recent developments have addressed some of Cushman's criticisms. JCS reforms have increased the role of the theater CINCs in the requirements and budget process. Formation of the Assistant Secretary for Command, Control, Communications, and Intelligence position as well as the Joint Tactical Command, Control, and Communications Agency has provided a more central location to resolve interoperability and technical issues. Realistic evaluation of command and control systems is a problem. The recent reforms, test beds, and simulation can help in this regard, though the real problem is putting emphasis on realistic evaluation.

III. Conclusions: Cushman raises some valid concerns in his book. In doing so, he provides a good introductory background to the issues and nature of theater command and control. In recommending an evolutionary acquisition approach, he neglects somewhat the implementation problems and required mixture of user and developer roles. Recent developments have the potential to solve some of the problems Cushman raises, but will require continual solid execution.

IV. Recommendation: Military personnel read this book.

Chapter I

INTRODUCTION AND PERSPECTIVES

Effective command and control has been a concern since the earliest thinking on the subject of warfare. In his book, The Art of War, Sun Tzu addressed this critical element when he quoted this ancient advice:

On the field of battle, the spoken word does not carry far enough; hence the institution of gongs and drums. Nor can ordinary objects be seen clearly enough; hence the institution of banners and flags. Gongs and drums, banners and flags, are the means whereby the eyes and ears of the host may be focused on one particular point (21:14).

The importance of effective command and control takes on additional meaning as we attempt to overcome our numerical disadvantages and improve our combat capability through maneuver and Airland battle doctrine. One of the background concepts to this type of warfare is the importance of the "Boyd Theory", or the breaking of the enemy's cohesion and will through implementation of a quicker observation-orientation-decision-action cycle than one's opponent (14:90). To do this requires a command and control system, in its fullest meaning of sensors, communication links, operating procedures, intelligence processing, and warfighting outlook, that is highly effective and adaptable to the changing conditions of battle.

This paper will analyze a book, Command and Control of Theater Forces: Adequacy, by John H. Cushman, that looks at this important component of our combat capability. Cushman wrote this book, actually an update of a 1983 research report, because of an identified and growing concern over the adequacy of our command and control systems for theater forces. This concern had been raised by a 1978 joint study by the Army and Air Force science boards, a 1978 Defense Science Board (DSB) task force, and senior military and DOD leaders. Cushman's thesis is that the concerns raised are valid. Our command and control systems for theater forces are seriously deficient and in particular, due to certain specific problems, our institutions and approach for

acquiring these systems is creating a potential disaster should war come (1:1-2).

Cushman brings extensive experience to the subject. A retired U.S. Army lieutenant general, he commanded a number of operational units during his 38 year career, including the 101st Airborne Division at Fort Campbell and I Corps (ROK/U.S.) in South Korea. He also served as a staff officer in the Office of the Secretary of Defense, as military assistant to the Secretary of the Army, Commanding General of Fort Devens, Commanding General of the U.S. Army Combined Arms Center, and Commandant of the Army's Command and General Staff College. During the Armed Forces Communication and Electronics Association's (AFCEA) study on the evolutionary acquisition of command and control systems, he represented the user. He is currently a consultant in the fields of AirLand warfare, command and control of theater forces, and AirLand warfare simulation (1:269,3:777). This deep background Cushman brings to the subject is primarily from a user's and commander's perspective. One possible source of bias in his background might be that he does not have any direct experience in the development organizations (such as DARCOM, the Department of the Army Material Development and Readiness Command) of the acquisition process.

This author also brings a particular background and perspective to the analysis of Cushman's book. Having served nine years in B-52 crew and staff operations, the author has been exposed to command and control systems primarily in the strategic arena. Nonetheless, this experience serves as a background to the general concept of command and control and such issues as connectivity and the impact of degraded capability to successful operations. Similarly, participation in Red Flag, Quick Force, Maple Flag, and NATO exercises provided some experience in the conventional environment, at least with respect to the planning and execution of interdiction missions. Additionally, serving three years as a contracts manager in the simulator program office at Wright Patterson AFB provided insight into the acquisition process. In particular, this experience included seeing some of the problems of requirements definition and interaction of the contractor, user, and development organization Cushman addresses. This book was selected for analysis for two reasons. First is the importance, as discussed before, of the subject to our initiatives to improve our combat capability. Second is to learn more about the subject as background to SAC's evolving role in conventional operations.

With these perspectives in mind, this paper will analyze Cushman's book and discuss the validity of his assessments. To do this, the next chapter will provide a short synopsis of Cushman's book and conclusions. This will then be followed with an analysis of his conclusions by comparing and contrasting them with other sources and recent developments.

Chapter II

SYNOPSIS

Our performance in the acquisition of command and control systems for theater forces has been gravely deficient. Although the command and control systems in the hands of field forces of the United States and of our allies alongside whom we are deployed may possibly be adequate for conditions short of war, any realistic audit will show that they will be seriously inadequate should war occur (1:247).

This is the overall assessment of the adequacy of our systems for command and control of theater forces that Cushman arrives at in Chapter VI of his book. As he admits, this is a partial assessment due to technical and security limitations, but one which he feels would be arrived at in a comprehensive audit and one which predicts potential disaster (1:247). His support for the general assessment in Chapter VI is quite limited. Drawing on interviews at the Office of Net Assessment, a report by BDM Corporation, and a study of Soviet acquisition methods, he cites three U.S. weaknesses versus Soviet capabilities. One, the Soviets have a much more integrated and holistic view of the role of command and control. This includes closely integrating it into their operational concept, and planning for disruption of our capabilities. Two, they pay much more attention to the possible loss of their own capability and means to reconstitute. Three, they develop their systems in an incremental, evolutionary approach which often gives them advantages in reliability, compatibility, and readiness (1:245). In addition, he points out the vulnerability of U.S. systems, quoting for example MGen J. C. Pfantz, former Director of Intelligence in U.S. Pacific Command, whose judgment was the Pacific system was "vulnerable to the most rudimentary form of enemy attack..." (1:246).

As stated before, Cushman recognizes the limitations of his overall assessment. As the introductory quote points out, the real emphasis of the assessment is on the acquisition of command and control systems, rather than the state of the entire system. It is in this area that Cushman spends most of his time, building a case for both our poor condition and recommendations for improvement.

He summarizes the more specific failings of our systems by saying:

Theater forces' command and control systems are not well tied together, top to bottom. They are not being exercised adequately under the expected conditions of war. Great sections of them will probably not survive the attack against them which is sure to come in war. For the typical senior commander, allied or U.S., whose forces must use these systems, they represent the largely unplanned splicing together of ill-fitting components which have been delivered to his forces by relatively independent parties far away who have coordinated adequately neither with him and his staff nor with each other. And they neither exploit the present capabilities of technology, nor does the system for their development adequately provide that future systems will (1:247).

In Cushman's view, the above failure of our acquisition system is due to two sets of causes: conceptual/technical and bureaucratic/institutional (1:180).

Conceptual/technical causes result from our failure to understand the unique nature of command and control systems and factor this uniqueness into the acquisition process. The first of these is the failure to view command and control systems as living webs (1:180). In the book's first chapter, "The Nature of Theater Forces and of Their Command and Control", Cushman provides an introductory look at this living web. Running from the army group to corps to division to brigade to battalion to companies, the land component of the system might consist of 200 maneuver companies with 2000 squads/sections. At each level, there can be a mix of groups such as intelligence, logistics, air defense, field artillery, and electronic warfare systems. Overlaid with this, the air component has its own complex organization. The command and control systems at each level are subsystems of the higher level. Each system consists not only of equipment such as sensors, computers, and communication links, but also the people who use the equipment and the procedures they have worked out. The differing missions, potential enemies, operational areas, and force composition will make each total system unique, though many of the components will be the same. Each of these systems is constantly changing with equipment being added, modified, or taken out (1:Ch I). This uniqueness and evolving nature must be taken into account when developing master plans. This is not always done. For example, an early IAC plan failed to recognize the differing European, Pacific, and U.S. environments. The result was a plan for a general type of system that did not provide a specific

roadmap to meet unique theater requirements. The acquisition process must similarly recognize the equipment being developed will be put into an existing, dynamic system. In Cushman's view, this type of understanding is not feasible for an outside development organization (1:180-182).

The traditional acquisition approach, when coupled with this lack of understanding, is the second conceptual/technical cause of our problems. This traditional approach emphasizes the front end determination of requirements. These requirements are then frozen to create a stable production program and completed units are tested against the specified requirements. Cushman cites a 1981 study by AFCEA that found this traditional approach usually results in failure and that an evolutionary approach, particularly for systems that augment a commander's decision making process, was more likely to result in success (1:183,146-147). The evolutionary approach Cushman says we are failing to use consists of an iterative process of small improvements. Basically, we should look at the living systems where they currently exist, quickly determine and field a core capability that provides a useful improvement, let the user operate and test the system for deficiencies and needed improvements, and then repeat the process. This approach requires a change facilitating architecture and successive rounds of small improvements (1:182-185).

To support this approach, Cushman agrees with the AFCEA conclusion that we need to "increase substantially the real user's involvement and influence" (1:185). This would require several steps. One, a user team needs to be formed to work on a daily basis as part of the acquisition team. Two, the user's requirements analysis capabilities need to be increased. This includes more people (to be drawn if necessary from the development organizations) and also evaluation tools such as test beds, prototypes, and simulations. Three, the user needs to be given the authority to decide when the added capability is ready for operational testing (1:185).

A third conceptual/technical failure is our neglecting to take advantage of the operational commander's sense of mission responsibility. He is out on the front lines and his concern for readiness produces a sense of urgency that may be lost in the development organizations. Cushman points out several examples where this urgency has driven field commanders to do what is necessary to improve their capability. For instance, when the system was slow to provide scanners and signal analyzers for electronic intelligence, field units used training funds to buy them from Radio Shack and Bearcat. In his 1982 visit to Germany,

he saw units doing their own evolutionary improvements. In one such case, he saw tactical units developing their own software for mission planning on small computers bought by TAC (1:186-187).

Cushman's fourth conceptual/technical cause of our poor performance is the failure to use readily available commercial equipment. He cites a 1982 General Accounting Office (GAO) report that supported the capability of commercial equipment for many military jobs by stating: "...there have been many advances in [commercial] computer technology. These advances are the result of demands made by the civilian sector for more reliable and rugged computers..." (1:191).

In Cushman's view, we are doing this now with good success, but not to a sufficient degree. He points out several success stories, such as the following example. In the early 1970's, the Tri-Service Joint Tactical Communications Office (TRI-TAC) began development of the Communications System Control Element (CSCE) to help automate critical tasks such as frequency assignments and circuit routings. In 1979 the program was still bogged down and the Army's Center for Systems Engineering and Integration, working with the user, decided to use commercial equipment in an evolutionary approach. They awarded a contract in 1980 and units were fielded in 1985 (1:192).

Cushman's final conceptual/technical problem is our failure to develop an architectural approach which can handle changes and facilitate interoperability. This architecture is necessary to avoid documented problems with interoperability, but becomes even more critical under an evolutionary acquisition approach. As the AFCEA group pointed out: "a potential for chaos exists ... without an architectural framework [with] flexibility to facilitate growth" (1:194).

These five problems then, in Cushman's view, form a conceptual/ technical obstacle to our fielding effective command and control systems. We don't view the systems as living, unique webs. We don't take advantage of the user's sense of urgency in the acquisition process. We don't use an evolutionary approach in acquiring the systems. We don't use available commercial equipment sufficiently. We don't have an architectural framework to facilitate interoperability and orderly change. But Cushman also sees bureaucratic/institutional sources of our problems.

Cushman believes there are four specific bureaucratic/institutional causes for our poor performance, and these will be more difficult to correct. The first of these is the failure of acquisition authorities to see command and control systems holistically. Instead, each of the services and their acquisition agencies determine requirements, fund, and produce systems from their own compartmentalized outlook, and not with a view of how those systems will fit into the complex, linked web of systems described earlier (1:198). He cites a number of examples of resulting incompatibility throughout the book. One such case is the independent development of firecontrol systems by the Army (TACFIRE) and the Marines (MIFASS). The result is two systems that can't talk to each other due to different digital languages and the lack of automated firecontrol if one of them has to take firing instructions from the other. He follows this up by stating the problem is now being worked but with the loss of time, money, and ready capability (1:200).

The resulting problems of incompatibility become even more important and apparent when considering how to fight a theater AirLand battle. According to Cushman, plans for attacking the second echelon contain many pitfalls, both in conceptual and hardware terms. He points out a number of movements to begin to address these problems such as the Joint Tactical Fusion Program to bring together intelligence, coordinating mechanisms such as the AirLand Force Application activity at Langley AFB, and also procedural development to define NATO battlefield air interdiction. Overall, however, he feels too many problems remain unresolved due to this failure to take a more integrated, holistic view (1:200-203).

This first bureaucratic/institutional failing is compounded by a second. We don't give sufficient influence and authority in the acquisition process to the theater CINCs. These commanders are the one group that is driven by the mission to take an integrated view. Cushman outlines the development of this problem in Chapter II, "The Command Structure of Theater Forces and Its Evolution." The basic problem arises from the chain of command and peacetime versus wartime responsibilities and authority as defined in JCS Publication 2, the "United Action Armed Forces" (UNAAF). Quoting this publication, he points out the individual services have the responsibility for: "...organizing, training, equipping and providing forces to fulfill certain specific combatant functions and for administering and supporting such forces" (1:68). At the same time, the unified commander is responsible for the performance of the actual military mission. These commanders have "full

operational command over the forces assigned" (1:68); however, this "does not include such matters as administration, discipline, internal organization and unit training" (1:70).

Cushman feels the unified commanders have no doubt they have sufficient authority in war to get the job done. The problem is in peacetime preparation for such tasks as planning; developing operational concepts, procedures and command relationships; and installing command and control systems (1:73). This lack of peacetime authority, and the fact that the services control the money and people, leaves the unified commanders with too little influence in the acquisition process (1:74-75).

The development of what is known as the CINC Initiatives is viewed by Cushman as a positive step towards correcting this problem. This program grew out of the 1978 DSB task force talked about previously. It made a number of recommendations to include providing the CINCs with money and manpower to improve their command and control systems. This led to \$8.8 million in fiscal year 1981 that the CINCs could use at their discretion, within certain specified limits, for near-term fixes. Progress on providing manpower to the CINCs has not fared as well. Their 1979 request for 60-70 people was put off, then denied in 1982. (1:204-211).

The third bureaucratic/institutional problem Cushman points out is the failure of any institution, particularly the Joint Chiefs of Staff (JCS), to force the services to acquire command and control systems from a holistic, unified commander's point of view. He reviews the criticisms of the JCS as being unable to come up with clear joint perspective positions due to the parochial orientation of its members and the negotiation process that is used to resolve conflict. This process particularly impacts decisions on command and control systems which are by nature often multiservice and contentious (1:216-218). As an example, he points out the fact that JCS Publication 12, "Tactical Command and Control Planning Guidance for Joint Operations", does not require artillery control systems from an Army battalion to communicate with systems from a Marine regiment, nor a Marine battalion to an Army division. This guidance, which is supposed to be used for developing service command and control systems, is insufficient in his view for a truly integrated system. He believes this is an example of individual doctrines refusing to admit they might need to take orders from other service components (1:221-224).

Cushman notes several improvements that have taken place to improve joint perspective. One is the establishment in 1979 of the Command, Control, and Communications Directorate in the Joint Staff. He sees this as a significant development and one that has already made improvements in communications security master planning, allied interoperability, and resource allocation (1:220). A second positive improvement is the addition in 1981 of the Chairman of the JCS as a member of the Defense Resources Board. This he feels will free the Chairman to provide a more independent input. A third positive step was the 1982 JCS memo on steps to improve and consolidate command and control management which led to the establishment of an Executive Committee to oversee these programs (1:219-220, 224-225).

The fourth bureaucratic/institutional problem in Cushman's view is that we don't evaluate system performance under realistic conditions. We don't take into account the holistic requirements of the system discussed before, and we don't recognize the considerable degradation in capability that will result from enemy actions. This failure involves both developers and the theater forces themselves. On the developer's side we need to have systems built and tested to provide for essential needs under war conditions. At the same time, the theater forces too often are training with fully operational systems and not developing operating procedures that will meet essential needs with degraded capability. The result is too much message traffic and excessive use of precedence. In war, this will collapse the system. To combat these failures, we must streamline our operational procedures and make greater use of realistic two-sided battle simulations (1:227-232).

These four factors then produce a bureaucratic/institutional obstacle to the adequate fielding of theater command and control systems. One, acquisition authorities look at the systems from a compartmentalized, service orientation versus an integrated whole. Two, the theater commanders don't have sufficient influence in the process. Three, no institution, particularly the JCS, has been able to force the acquisition system to take an integrated approach. And four, theater command and control systems are not realistically evaluated in development or operationally.

With this synopsis as a background, the next chapter will analyze Cushman's assessment of the problems in our acquisition approach. There is some overlap between Cushman's two groupings of our problems. For this analysis, his causes of our poor performance will be consolidated into a single group. The first item will be our failure to view

command and control systems as complex, living webs and holistic systems across all components. As he points out, this failure can result from either a lack of technical understanding or from bureaucratic parochialism. The second item will be Cushman's technical/conceptual criticisms of our failure to use an evolutionary approach incorporating available commercial equipment. The third item will be our failure to fully utilize and incorporate the user's perspective, either directly or through the JCS, in the acquisition process. This incorporates one of Cushman's technical/conceptual criticisms and two of his bureaucratic/institutional criticisms. The fourth item will be the need to develop an architecture for interoperability and the fifth item will be our failure to realistically evaluate our command and control systems.

Chapter III

ANALYSIS

There is an enemy out there. He means us ill. He tests us daily and we must react or test him with a very high order of skill. One day he may test us quite seriously. That enemy outnumbered us and will almost surely outweigh us at every point where the forces may clash. But when the war starts...our theater forces and those of our allies, if we are in a position to do so, can thwart him We are not yet in a position to do so, and we will never be unless we press ahead vigorously with a comprehensive institutional reform ... (1:12).

To begin this analysis of Cushman's assessment of our process for acquiring command and control systems, the issue of interoperability will be looked at. This will be done because as Cushman states: "broadly defined, [it] is the greatest single problem in theater forces" (1:35). It also brings to the discussion two of the five specific criticisms. One is our failure to understand command and control systems as unique, holistic, living webs. The second is the need for architectural development to facilitate interoperability.

Operation Urgent Fury, the Grenada mission, has raised a number of criticisms of military performance, including command and control. In his book, Military Incompetence, Richard Gabriel points out such problems as poor intelligence and lack of coordination between units. He cites such examples as Navy air strikes on Army positions, Army and Marine units unable to talk to each other due to differing frequency assignments, and Army units having to call back to Ft. Bragg to coordinate air strikes (2:174, 178).

In response to such problems, the General Accounting Office (GAO) performed a review and determined that indeed such interoperability problems continue to exist. In their review of information on 24 joint exercises from 1979-85, they found 80 cases of interoperability problems. The causes of these problems included equipment, procedures, doctrine, and training (23:12). Similarly, in an audit of the Pacific theater, the GAO found many examples of

interoperability problems. In some instances, this was due to each service having different funding priorities or fielding schedules. For example, they found each service in a different stage of conversion to a new communications encryption device. The Army was basically done, the Navy estimated completion in five years as they only installed when ships came into drydock, and the Air Force was slow due to scheduling a squadron at a time for conversion (23:13).

In other cases, the problem was service preference for their own systems. The Regency Net System, a program for secure, jam resistant, high frequency communications was one example. Here, the Navy wanted to develop their own system which was to be compatible with Regency Net. The GAO estimated this will delay a fully operational system by five years (6:16). There can be legitimate reasons for services choosing their own systems such as weight, reliability, and environmental conditions. Such selection, however, can impact interoperability by introducing technical problems or, as seen before, different fielding schedules.

These sorts of examples of differing priorities, schedules, and equipment preferences indicate, as Cushman asserts, we do tend to focus on the individual pieces rather than the command and control system as a whole.

Even if this were not so, the GAO found management problems as a source of interoperability problems. In particular, they cite a 1983 Institute for Defense Analysis study which found a "major problem is a lack of adequate joint user needs and requirements ..." (23:17). The GAO also cited a 1985 Navy study which concluded the problem was a lack of minimum essential interoperability requirements. With this absence, each service was free to define its own requirements (23:17). Such was the case when the Air Force and Navy began work on the Joint Tactical Information Distribution System (JTIDS). Each service chose different technological approaches which were not interoperable. This raised Congressional concerns and in 1985 they restricted funding to only one program. This resulted in the cancellation of the Navy program on which \$100 million had already been spent (23:17).

The issuance of a new Department of Defense (DOD) Directive 4630.5 in 1985 is a step to solve some of these problems. However, its long revision cycle led Donald Latham, Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)), to testify the process had been "frustrated by Pentagon bureaucracy" (5:16), illustrating the service parochialism that Cushman criticizes. The revision of this directive, "Compatibility

and Interoperability of Tactical Command, Control, Communications, and Intelligence", does take positive steps. It addresses interoperability from a management perspective and establishes a methodology for lifetime management. It attempts to do this by requiring a review before authorizing one-of-a-kind use, a Joint Chiefs of Staff (JCS) determination of the operational basis for compatibility, and strengthening the role of the newly organized Joint Tactical Command, Control, and Communications Agency (JTC3A) (S:16).

JTC3A, originally formed in 1984, is a step towards solving Cushman's criticism of a lack of a "strong central organization" (1:164-167) for command and control. It has a number of responsibilities to ensure interoperability. The first of these is to develop an architecture for interoperability. This architecture is required to provide an overall plan for linking command and control systems, to define critical interfaces and essential tasks for achieving interoperability, and to form a base for technical standards. The JTC3A is making progress in this effort and in its first year developed an overall, three-layered approach to the architecture. In addition to this general approach, it developed specific bottom-up architectures for the coastal defense mission and for a Southern Command operations plan (23:40-44). The agency also manages the Joint Interoperability of Tactical Command and Control System (JINTACCS) program to establish joint service procedural standards for message formats. These standards will facilitate digital transmission of information while ensuring common formats that will be man-readable (23:44). JTC3A also provides products and services such as command and control planning before and during exercises and conducting developmental, operational, and certification testing (23:48-49). A congressional report assessed the JTC3A as being a feasible approach to solving the interoperability problems, but concerns over slow architectural development, approving standards, and verification of older systems means the process will be an extended one (24:2).

Even projecting out such positive steps as the new DOD Directive 4630.5 and the good, but partial, work of the JTC3A, interoperability will probably always present a problem. As Lt Gen C. E. McKnight, former JCS Director of Command, Control, and Communications Systems, has pointed out, the dynamic nature of training, doctrine, procedures, force structure, and hardware will always create less than full compatibility. In his view, however, interoperability can be achieved in any given operation by careful logistics support and planning for combat nets, frequencies, and cryptographic devices (15:19). In individual crisis or small

scale conflicts there probably is room to correct more fundamental system problems through careful planning and shifting assets. This is likely to be more difficult, however, as conflict moves up towards larger scale theater actions.

Lack of such planning has caused some of our past interoperability problems. Donald Latham points to a lack of planning as the main problem in Grenada. More than a lack of time, it was a problem of not recognizing the importance of a detailed communications plan. As a result, incompatibilities in frequencies and hardware occurred which could have been avoided. He feels these important lessons have now been factored into the procedural process (16:60). The failure to adequately plan for Grenada is indicative of two concerns Cushman raises. One, it shows a failure to grasp the total systems nature of command and control, and two, the lack of communications emphasis is similar to Cushman's point on how we downplay its role in exercises.

In summary, interoperability problems continue to exist. Their existence arises from a failure to understand the nature of command and control, service parochialism, and the lack of an architecture for interoperability. These are all problems Cushman raises. Some progress is being made, such as the new DOD directive on interoperability and the formation of the JTC3A, but the process will be extended. Proper emphasis, planning, and logistics support can help achieve interoperability, but this requires a good understanding of the nature of command and control systems, and becomes more difficult as the operation moves up to total theater size.

The second point to be looked at is Cushman's suggestion we use an evolutionary approach incorporating commercial equipment. This approach seeks to improve the acquisition process by fielding equipment sooner and also by involving the user more.

A panel, representing a mixture of major command (MAJCOM), acquisition agency, and user viewpoints, concluded initiatives using evolutionary approaches have shown to improve command and control capabilities (7:74). One advantage of this approach is an earlier decision on requirements. One of the large delays in fielding equipment is in the requirements process. There is a tendency to delay a firm requirements definition to take advantage of the latest technological advances. In fields like computers and communications where technology is rapidly changing, this can result in a seemingly never ending process that can cause considerable delay in programs. An evolutionary approach, which plans on further successive improvements,

helps relieve some of the stress of making the starting decision (6:25-26).

The advantages of increased user involvement can be seen in the modernization of a Southwest Asia command center. In this case, the manual procedures had to be depersonalized and translated into an automated system. In an incremental fashion, the command center was first updated with a semi-automated system. This allowed the user to develop new operational concepts which could then be translated into the requirements of a fully automated system. In addition to helping define requirements, this approach reduced the resistance to change and allowed the personnel to grow with the system (18:45,48).

However, there are also obstacles to implementing this approach. One of these is stability in funding. This is a problem for many programs but particularly so under an evolutionary approach. One of the reasons for using this approach is the difficulty in defining the initial requirements. This approach works around the problem by settling for a small initial improvement, with the understanding later improvements will be added. By settling for a smaller initial jump in capability, particularly when coupled with the difficulty of defining command and control's impact on warfighting capability, programs under this approach suffer relative to other programs in budget battles. Thus, when compared to the larger and more quantifiable combat contributions of additional tanks or airplanes, programs under this approach may be given less priority. This is compounded by other problems such as each subsequent improvement being treated as a new start, and the difficulty of defining such things as final operational capability and life cycle costs. All of these complicate the progress of this approach in the programming and budgeting process (7:74, 20:107-108).

Though not brought out by Cushman, the AFCEA study he cites as recommending an evolutionary approach raises this as an obstacle. It points out the need to tailor the requirements and budget process if evolutionary approaches are to be successfully supported. Such tailoring would include a number of items. For example, in analyzing the benefits of these programs, their capability should be stated in terms of a broad range to take into account their undefined and evolving nature. These programs would then compete with other programs on the basis of any value within this range of possible capability. Only if it were likely the benefits would fall below some designated capability threshold, would they be rejected outright (22:III-57 - III-64). There are additional areas that have to be addressed in using evolutionary approaches.

One of the important issues in using an evolutionary approach is determining the scope and method of user involvement. On the one hand, some argue for the formation of an independent program office in the user's organization to manage command and control programs (25:13-18). Cushman is somewhat unclear on this issue. At times, he doesn't argue for such a total shift when he states:

The solution, however, is not to give the multiservice/multinational commanders of theater forces the resources and their management. It is to give these commanders adequate institutional means to influence these resources (1:7).

He states specific reasons for having development and service organization functions. They help ensure interoperability between organizations and logistics standardization. They also are needed to write the contracts, supervise the spending of money, and manage the overall budget process (1:151). At the same time, however, he sees this development and service superstructure as a fundamental problem. This is seen when he states:

One fundamental cause, the removal of which is absolutely essential to any substantial improvement in our acquisition performance, is the almost impossible bureaucratic superstructure and funding/approval process...(1:77).

He resolves this ambiguous position somewhat by stating that "the user and the provider must work together as a team throughout the full, repetitive cycle" (1:152) and that we must:

Turnaround the system for developing aids to command and control. Place much greater responsibility where the problem of command and control is--with the field commander himself. He does not need to build the material himself; that is still the job of the provider. But place in support of that commander both technical skills and material and then charge him with responsibility for using the provider to improve his own command and control systems (1:188).

Since Cushman defines the provider as the manufacturers (1:151), he appears to be arguing for a direct manufacturer-user relationship, with current development/service organizations serving more administrative functions. This would be a considerable change from the current system, analagous to the idea of creating a program office in the user's organization mentioned earlier. He also appears to be arguing for a variation in this shift, depending on the

echelon the command and control system will be at. He states for example, the theater commander's interests will dominate at the higher level theater systems while at the lower levels service developers can have more of a role (1:162).

A major shift to the user supplanting the traditional developer's role, as Cushman advocates at times, can present problems. One is the user's "requirements" cannot always be taken at face value. In some cases, they will represent the result of user talks with specific manufacturers (17:20). The author saw this in simulator acquisitions, where for example, the user thought a requirement existed for a specific control loading system. While the system they wanted was one of the best on the market, there were other systems sufficiently capable. Inserting the user's "requirement" as a firm solicitation requirement would have reduced competition and potentially increased costs. Such unchecked user requirements can result in technical errors and can also reduce the competitiveness of the acquisition. The validation and control of requirements is particularly important in an evolutionary approach to acquiring command and control systems. By its nature, what is required for command and control, and decisionmaking, is often a personal judgment. This can lead to requirements that suit individual users/commanders and organizational missions but not the overall mission requirements. At the same time, these requirements may not suit follow-on users/commanders (20:109-110). Similarly, direct user development of software, as in some of Cushman's examples, has created faulty firecontrol and engagement algorithms in some instances (7:76). While validation of requirements could be done by an expanded user technical staff, they would represent a less independent view than an outside development organization. This would also require additional personnel, more in the author's opinion than the 3-10 people (1:213) Cushman is talking about. As will be seen later, personnel with these skills are already in short supply.

There are other problems with using an evolutionary approach that argue for less than the shift in user roles Cushman feels is necessary. The development of objective test and evaluation criteria remains a problem. Under traditional acquisition approaches, the test and evaluation criteria are developed from the firm requirements statement and resulting specifications for the system. These firm requirements do not exist at the beginning of an evolutionary program. This is also complicated by the greater role of the user in the testing program, versus an independent testing organization. This different testing environment then requires a mixture of user and independent

tester roles. The AFCEA study recommended the user be responsible for operational utility testing against mission requirements, tactics, and man-machine interfaces. At the same time, the independent tester has an important role in evaluating reliability and maintainability, providing expertise in experimental design, data acquisition and analysis, and assessing the system's capability for growth (22:IV-16 - IV-20). Similarly, while developing operating procedures, maintenance capability, and training are tasks under any acquisition approach, they become even more challenging under the evolving nature of an evolutionary approach. As each succeeding stage of system growth occurs, all these tasks must again be addressed (7:74-76). Shifting too much of the acquisition responsibility to the user risks not having sufficient technical people to solve these types of problems, as well as diverting the user from operational matters. The panel cited earlier found that while evolutionary approaches improve the success of command and control acquisitions, the key was a careful blending of the roles of the user and the developer (7:74-76).

One of the major conclusions the AFCEA study made was a "business-as-usual" attitude will not support successful evolutionary approaches. In addition to the requirements, budgeting, and testing issues discussed before, the study points out a number of impacts of evolutionary approaches. These include such things as contract type, maintaining competition, source selection criteria, and configuration management (22:III-60 - III-73). In advocating an evolutionary approach, Cushman points out a couple of changes needed, such as the users requiring additional technical personnel and their own funds. Also, in discussing the CINCs Initiative, he points out the Joint Logistics Commanders (JLC) concerns on configuration management, personnel shortages, and duplication of effort (1:208). He presents these, however, as more of an example of bureaucratic resistance than real issues to be faced. Though his discussion ignores some of the technical obstacles in using evolutionary approaches, bureaucratic resistance is one of the major problems. To modify the many necessary areas will require considerable changes in attitudes as well as education. The recent unanimous support of the approach by the JLCs should help accomplish this. In announcing their support, they also agreed to: "assist subordinate commanders and their program managers in negotiating any special arrangements which might be required to successfully implement evolutionary acquisition" (13:23).

Overall then, while an evolutionary approach can help improve the fielding of command and control systems, there are difficulties in using the approach. Changes in attitudes and numerous procedures are required if such

problems as competing in the budget process, testing and evaluation, contracting issues, and training are to be solved. A successful blending of the user and developer roles is a key to solving some of the more specific problems. On this point, Cushman somewhat neglects these problems and argues for a more total shift to the user that ignores this required blending.

Another one of Cushman's criticisms was the failure of any organization, particularly the JCS, to focus attention on command and control problems and resolve interservice rivalry. There have been a number of recent changes that address these issues.

One of these is the creation in 1985 of an Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)). This office now has direction and control of the Defense Mapping Agency, the Defense Communications Agency, and the JIC3A, as well as staff supervision over the Defense Intelligence Agency. In creating this position, Secretary Weinberger said:

...it is important that there should be a central management mechanism for the review of DOD wide C3I (command, control, communications, and intelligence) issues to establish priorities, make the tradeoffs ...and make effective decisions and recommendations ... (10:6).

One improvement from this change is the ASD(C3I) will be a member of the Defense Resources Board (DRB), allowing him or her to present and comment on issues directly. Donald Latham, the first ASD(C3I), also sees the elevation of the position from deputy undersecretary to assistant secretary as providing additional position authority within the bureaucracy (16:58).

The DOD Reorganization Act of 1986 has also addressed some of Cushman's concerns. The creation of a Vice Chairman of the JCS offers significant advantages in increasing theater commanders' influence. Though his exact duties are not specifically delineated, the first Vice Chairman, Gen Herres, has been given the responsibility to champion the CINCs. He has several avenues to do this. One is, by supervising the overall planning of theater operational plans, he will be deeply knowledgeable on their requirements and shortfalls. Coupled with his duties on the DRB, as Vice Chairman of the Defense Acquisition Board, and as Chairman of the Joint Requirements Oversight Council, the Vice Chairman will be in a strong position to advocate theater needs (12:40). The strengthening of the Chairman of the JCS's role by making him the principal military advisor and

putting the Joint Staff under him directly address Cushman's criticisms of a lack of consensus breaking, independent judgments (12:41). Though time will be needed to fully assess the effectiveness of these reforms, they appear to be making good progress (19:19). In fact, Gen Herres has cautioned on the need to not go overboard in shifting power to the CINCs at the expense of the services. With too much influence, he feels the CINCs would tend to develop forces too unique to their own needs/theaters, thus reducing total force flexibility (19:20).

Another recent development, already discussed, is the formation of the JTC3A and its subsequent strengthening. As pointed out, this agency has central responsibility for interoperability and is making progress by developing architectures, common standards, and doing certification testing. In Congressional testimony its director, Maj Gen Archibald, expressed two concerns limiting its progress. The first is manpower. It has received only about 300 of its 400 requested personnel. As a result, they have been forced to contract out some work and neglect other work. In fact, he explained this is why he wasn't able to assign technical specialists to the combatant commands, as Cushman recommends (23:55). The second problem is lack of authority. While Maj Gen Archibald felt he had access to required information on service programs, he did "not have authority nor direct leverage to influence the PPBS [planning, programming, budgeting system] if nonconcurrence to [his] recommendations is received.... In such instances these issues are [need to be] referred to the ASD(C3I) or the JCS for resolution" (23:60). While as Cushman points out, the JCS might not previously have been able to resolve such issues, the reforms just discussed have improved the chances.

The combination of these reforms represents a considerable shift in both the CINCs' influence and centralized emphasis on command and control issues. This shift does much to address Cushman's criticisms. The strengthening of the CJCS and creation of the Vice Chairman's role as the CINCs' advocate provides machinery to resolve interservice conflicts and bring the theater requirements into the budgeting process. Similarly, the creation of the ASD(C3I) and JTC3A provides both a high level consolidation point for command and control issues, as well as technical developments. While these reforms do not give the CINCs their own budgets or the people Cushman feels is necessary, they do provide a vehicle for the same results. As Lt Gen McKnight has said: "The management structure is there. We do not need to expend effort creating new organizational structures.... We need to make effective use of the existing structure" (15:20). These reforms are still recent however. Much will probably depend

on how the machinery is actually executed on a daily basis, but with the reforms the potential is there.

Cushman's final criticism is we don't realistically evaluate our command and control systems either in development or in operation. On the development side, this means we must evaluate system requirements for essential needs, not the "nice-to-have-needs" (1:128). If this is not done, not only will development times take longer, but sufficient quantities may not be able to be purchased. The recent reforms discussed previously should help in this regard. But as Donald Latham has said: "we've got to have a guy somewhere in the system that is willing to be an absolute Godzilla with regard to requirements" (16:70). After careful requirements evaluation, the development side must also realistically evaluate systems being designed. The use of test beds can do much to realistically evaluate systems in development. They, for example, can help resolve technological and architectural issues, help develop survivability under combat conditions, and help permit incremental upgrading without obsolescence (11:xi). The JIC3A has two test beds to help in this regard, and plans to consolidate them to permit end-to-end testing of entire systems (23:49).

There are also problems, as Cushman says, in the realism of operational evaluation. A study of U.S./ NATO command and control capabilities found:

Basically, C3 systems are vulnerable physically and wartime C3 systems are not exercised under realistic conditions. Rehearsals and maneuvers do not adequately reflect combat conditions. To the extent the employment of C3 systems is tested, it is under peacetime conditions and under the U.S. command structure, not the NATO command structure that would be operative in wartime (9:73).

Retired USAF Col Alan D. Campen has pointed out a number of reasons for our failure to incorporate realism in exercises. Part of it is due to the relatively benign command and control environment of our Vietnam experience. Some of it is also due to neglect of the concept of friction in war. This concept tells us the perfect plan or piece of hardware seldom works as well in war as in peacetime. Many factors such as uncertainty, fear, and confusion can exist which can degrade performance. Similarly, we see our sophisticated systems working well in the laboratory, in the field, and in crisis situations that permit us to concentrate assets, and assume that will carry over into combat. A more specific problem is how to incorporate

degraded command and control into exercises without totally disrupting the objectives (8:22).

Campen sees simulation, as Cushman recommends, as a solution to this problem. In particular, technical advances now allow speedy simulations of multiple scenarios, sophisticated models to be run on smaller, more available computers, and the linking of both physical and decision processes into battle outcomes. These capabilities can heighten awareness of command and control in combat, allow experimentation with doctrine and procedures, and push staffs to the breaking point without collapsing the total exercise (8:22-23). Notwithstanding these technical advances, there are difficulties to using simulation. One is the time and cost of developing a realistic wargame. For example, the Tactical Air Defense System model was developed to analyze a limited hypothetical air defense system. It's estimated the background mathematical structure and coding took about two to three man-years of effort and the specific scenario information an additional three man-months of effort (26:--). A second problem is the technical difficulty of actually modeling all the variables of a command and control system with battle interactions. Another reason is resistance to both the concept of simulation and the intricacies of command and control itself. A fourth reason is difficulty in factoring the personal nature of command and control into the simulation (4:41).

Again, Cushman raises a valid point on our evaluation of command and control systems. Because of a number of factors, we don't evaluate it realistically. There are tools such as test beds and simulations that can help provide realistic evaluations. Though there are cost and development constraints such as modeling realistic complexities, the major problem is probably more related to Cushman's first criticism. We tend to not understand the full nature of command and control, and consequently don't put enough emphasis on it during evaluations.

Cushman's book provides a good look at the nature of command and control of theater forces and its problems. Though the emphasis of the book is on the acquisition process, its background discussion on the complex, living nature of command and control systems and theater command structures gives the unfamiliar reader an important introduction to the subject.

Cushman's assessment of the failure of our acquisition process for command and control systems raises valid concerns. The continuing problems of interoperability illustrate we often do fail to grasp the integrated, living

nature of command and control systems and that service parochialism contributes to the problem. The formation of the JTC3A is making progress towards solving some of the architectural problems Cushman points out, but progress is slow and the process will be extended. The evolutionary approach Cushman advocates offers an improved method but there are problems the book fails to bring out. One is the need to have an appropriate mix of developer and user influence in the process. Cushman's position is somewhat hazy on this issue. As a consequence, he sometimes overstates the role the user should have, at least in view of such potential problems as unvalidated requirements, personnel requirements, and detracting from the theater commander's operational focus as he assumes development responsibilities. There are also technical difficulties in implementing this approach, the biggest probably being succeeding in the budget process. Realistic evaluation of our command and control systems is a problem. As Cushman recommends, test beds and simulations can help overcome some of the real world problems of effective evaluation. These can, however, be difficult and costly to employ if they are to realistically model the key variables of combat.

Recent developments have done much to address Cushman's criticism on increasing the theater commander's influence. The strengthening of the Chairman of the JCS and the addition of a Vice Chairman as a CINCs' advocate provides machinery to bring theater requirements strongly into the acquisition process. Additionally, the formation of the JTC3A and ASD(C3I) will provide a central focus for resolving command and control issues. Though these reforms provide the potential, strong execution will be required if they are to really solve Cushman's concerns.

In total then, Cushman raises some key issues hindering our effective fielding of command and control systems. In raising these issues, his book provides an important introduction to the nature of theater command and control systems and the organizational process that provides them.

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